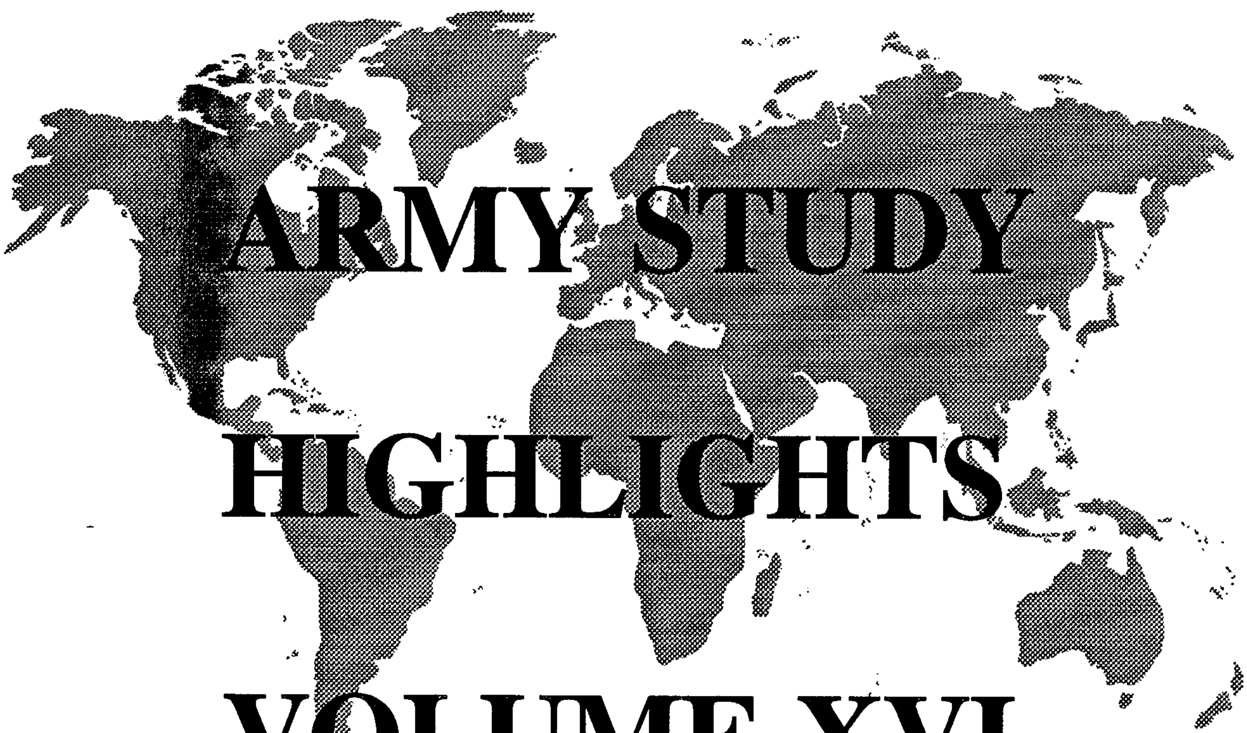

ARMY STUDY HIGHLIGHTS

VOLUME XVI

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MAY 1996

U. S. Army Model Improvement and Study Management Agency

Field Operating Agency of the

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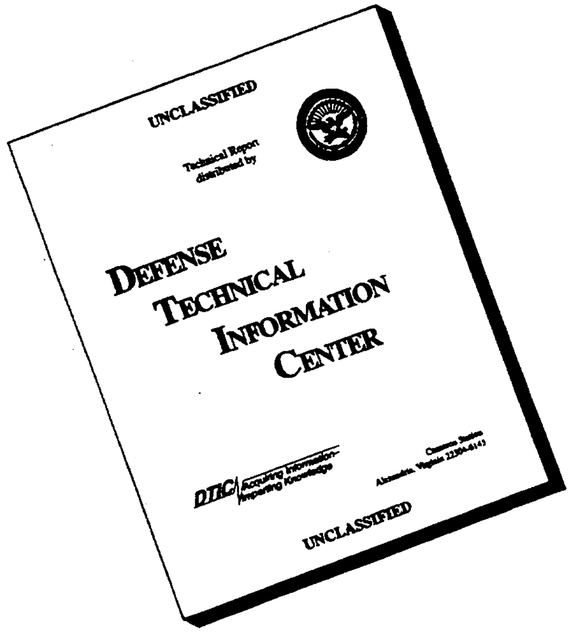

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1 May 1996

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SUBJECT: Army Study Highlights, Volume XVI

The Army Study Highlights is published annually to acknowledge outstanding efforts of individual and group analysts and to encourage continued excellence in the Army analysis community. The visibility provided by this publication is an opportunity for others to take advantage of examples of good work. A panel of experienced senior level analysts selected eleven studies for this volume. Those studies were quite varied which provided an interesting mix.

The selected studies represent examples of efforts that are of significance to the Army's missions and goals. Selections were based on an assessment of the principal findings, main assumptions, principal limitations, scope, objectives and approach of each study. Examples of quality analysis have proven to be beneficial to the younger analysts entering the analysis community as well as a refresher for the more experienced analysts. I urge you to make the widest possible distribution of this publication.

This volume also serves to recognize recipients of the 1995 Dr. Wilbur B. Payne Memorial Award for Excellence in Analysis. Two awards were presented this past year, one for the best individual authored paper and one for the best group authored paper. Each year these awards are presented at the Army Operations Research Symposium, Fort Lee, VA. We are proud to include excerpts of this outstanding work in the Army Study Highlights.

We welcome your suggestions. Comments and requests for additional copies of this publication should be directed to Ms. Gloria Brown, of this agency, (DSN) 327-3417 / (C) 703/607-3417.

JOANN H. LANGSTON, Director
Model Improvement and Study
Management Agency
Office of the Deputy Under Secretary
of the Army (Operations Research)

Secretary of the Army, ATTN: SASA, Pentagon, Room 3E700
Under Secretary of the Army, ATTN: SAUS, Pentagon, Room 3E732
Administrative Assistant to the Secretary of the Army, ATTN: SAAA, Pentagon, Room 3D746
Deputy Under Secretary of the Army (Operations Research), ATTN: SAUS-OR, Pentagon, Room 2E660
Assistant Secretary of the Army (Civil Works), ATTN: SAWC, Pentagon, Room 2E570
Assistant Secretary of the Army (Financial Management and Comptroller), ATTN: SAFM, Pentagon, Room 3E606
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Assistant Secretary of the Army (Manpower and Reserve Affairs), ATTN: SAMR, Pentagon, Room 2E594
Assistant Secretary of the Army (Research, Development and Acquisition), ATTN: SARD, Pentagon, Room 2E672
General Counsel, ATTN: SAGC, Pentagon, Room 2E722
Commander-in-Chief, US Army Europe and Seventh Army, ATTN: AEAGX-OR, APO AE 09014
Commander, US Army Training and Doctrine Command, ATTN: ATCG, Fort Monroe, VA 23651-5000
Commander, US Army Forces Command, ATTN:AFCG, Fort McPherson, GA 30330
Commander, US Army Materiel Command, ATTN: AMCCG, 5001 Eisenhower Avenue, Alexandria, VA 22333-0001
Commander, Eighth US Army, ATTN: CJG-3, Unit 15255, APO AP 96205-0028
Commander, US Army Intelligence & Security Command, ATTN: IACG, Nolan Building, 8825 Beulah Street, Fort Belvoir, VA 22060-5246
Commander, US Army Strategic Defense Command, ATTN: CSSDC-ZA, P.O. Box 15280, Arlington, VA 22202
Commander, US Army Corps of Engineers, ATTN: CECS-ZA, 20 Massachusetts Avenue, Washington, DC 20314-1000
Commander, US Army Pacific, ATTN: APRM-MC, Fort Shafter, HI 96858-5100
Commander, US Army Information Systems Command, ATTN: ASCG, Fort Huachica, AZ 85613
Commander, US Army Medical Command, ATTN: MCZX, Fort Sam Houston, TX 78234
Commander, US Army Military District of Washington, ATTN: ANCG, Fort McNair, Washington, DC 20319
Commander, US Army Military Traffic Management Command, ATTN: MT-CG, 5611 Columbia Pike, Falls Church, VA 22041-5050
Commander, US Army Criminal Investigation Command, ATTN: CICG-ZA, 6010 6th Street, Fort Belvoir, VA 22060-5246
Commander, US Army Operational Test and Evaluation Command, ATTN: CSTE-ZA, 4501 Ford Avenue Alexandria, VA 22302-1458
Commander, US Army Safety Center, ATTN: CSSC-ZA, Building 4905, Fort Rucker, AL 36362-5363

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Commander, US Army Military Enlistment Processing Command, ATTN: MCDR, 2500 Green Bay Road, North Chicago, IL 60064

Department of the Army, Deputy Chief of Staff for Intelligence, ATTN: DAMI-ZA, Pentagon, Room 2E464

Department of the Army, Deputy Chief of Staff for Logistics, ATTN: DALO-ZA, Pentagon, Room 3E560

Department of the Army, Deputy Chief of Staff for Personnel, ATTN: DAPE-ZA, Pentagon, Room 2E736

Department of the Army, Deputy Chief of Staff for Operations and Plans, ATTN: DAMO-ZA, Pentagon, Room 3E634

Director of Information Systems for Command, Control, Communications and Computers, ATTN: SAIS-ZA, Pentagon, Room 3E458

Director, US Army Research Institute for Behavioral and Social Sciences, ATTN: PERI-ZA, 5001 Eisenhower Avenue, Alexandria, VA 22333

Director, Program Analysis and Evaluation Directorate, ATTN: DACS-DPD- A, Pentagon, Room 3C718

Director, US Army Materiel Systems Analysis Activity, ATTN: AMXSY-D, Aberdeen Proving Ground, MD 21005-5071

Director, US Army Concepts Analysis Agency, ATTN: CSCA-ZA, 8120 Woodmont Avenue, Bethesda, MD 20814-2797

Director, US Army TRADOC Analysis Command, ATTN: ATRC-ZD, Fort Leavenworth, KS 66027-2345

Director, Office of Small and Disadvantaged Business Utilization, ATTN: SADBU, Pentagon, Room 2A712

Director, Strategic Studies Institute, ATTN: AWCI, Carlisle Barracks, PA 17013

Director, RAND, Arroyo Center, ATTN: HMRP-7, P.O. Box 2138, 1700 Main Street, Santa Monica, CA 90407-2138

Director, Engineer Strategic Studies Center, ATTN: CETEC-ES, 7701 Telegraph Road, Alexandria, VA 22315-3803

Chief, Army Reserve, ATTN: DAAR-ZA, Pentagon, Room 3E390

Chief of Public Affairs, ATTN: SAPA-ZA, Pentagon, Room 2E636

Chief, National Guard Bureau, ATTN: NGB-ZA, 111 South George Mason Drive, Arlington, VA 2220

Chief of Chaplains, ATTN: DACH-ZA, Pentagon, Room 2E444

The Inspector General, ATTN: SAIG-ZA, Pentagon, Room 1E736

The Surgeon General, ATTN: DASG-ZA, 5109 Leesburg Pike, Room 671, Falls Church, VA 22041-3158

The Judge Advocate General, ATTN: DAJA-ZA, Pentagon, Room 2E444

Superintendent, US Army Military Academy, ATTN: MARM-MS, West Point, NY 10996

Commandant, National Defense University, ATTN: Library, Fort McNair, Washington, DC 20319

Commandant, US Army War College, ATTN: Library, Carlisle Barracks, PA 17013

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Commandant, US Air War College, ATTN: Library, Maxwell Air Force Base, AL 36112

Commandant, Armed Forces Staff College, ATTN: Library, 7800 Hampton Boulevard, Norfolk, VA 23511

Army Library, ATTN: Study Office, Pentagon, Room 1A518

Defense Technical Information Center, ATTN: DTIC-BCP, 8725 John J. Kingman Road, Suite 0944, Fort Belvoir, VA 22060

Chief of Naval Operations, ATTN: N811, Pentagon, Room 4A510

Air Force Studies and Analysis Agency, ATTN: AFSAA, Pentagon, Room 1E388

US Marine Corps Combat Development Command, ATTN: C45, Quantico, VA 22134

Organization of the Joint Chiefs of Staff, ATTN: J8 DDWSO, Pentagon, Room 1E965

Office of the Under Secretary of Defense for Policy, ATTN: ODTUSDP/PSPR, Pentagon, Room 3A7&8

Office of the Director, OSD Studies and Federally Funded Research Development Center Programs, ATTN: API/FFRDC, Room 312, IDA Building, 2001 N. Beauregard, Alexandria, VA 22311

Office of the Director (PA&E), ATTN: ODPA&E, Pentagon, Room 3E835

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Model Improvement & Study Management Agency

CONTENTS

STUDY GISTS

Antitank Master Plan Quick Reaction Analysis (ATMP QRA) Study Gist

Study Purpose. This study had two purposes: to determine the operational effectiveness of the ATMP's Advanced Antitank Weapons Systems - Heavy (AAWS-H) family to provide analytical underpinnings for the ATMP and to answer congressional inquiries about the effectiveness of the tube launched, optically tracked, wire-guided (TOW) 2B follow-on antitank system.

Critical Issues Addressed. The Training and Doctrine Command (TRADOC) Commander tasked TRADOC Analysis Center (TRAC) to determine the operational effectiveness and contributions of the United States (US) Army Infantry School's ATMP AAWS-H family, given the projected Threat capabilities. The AAWS-H family consists of the Advanced Missile System - Heavy (AMS-H), the Line of Sight-Antitank (LOSAT), and the Enhanced Fiber Optic Guided Missile (EFOG-M) systems. An additional issue was, given the planned modernization of US land combat systems, what is the operational effectiveness impact of not fielding a replacement for the TOW 2B?

Objectives

Determine the impact on present Blue force effectiveness if the Threat force modernizes.

Determine the impact on Blue force effectiveness if the Blue force is modernized without fielding the AAWS-H family.

Determine the impact on Blue force effectiveness if the Blue force is modernized and the TOW 2B is replaced by the AMS-H. (Follow-on-to-TOW issue.)

Determine the impact on Blue force effectiveness if the Blue force is modernized and the AAWS-H family is fielded.

Principal Findings

As Threat capabilities increase, force modernization becomes critical.

When the Threat force modernizes, modernizing the Blue force without fielding the AAWS-H family restores the force effectiveness levels approximately to present levels.

When the Threat force modernizes, modernizing the Blue force and fielding the AMS-H results in an 20-80 percent improvement over the same Blue force equipped with the TOW 2B.

When the Threat force modernizes, modernizing the Blue force and fielding the AAWS-H family provides the greatest increase in force effectiveness (up to 118 percent increase).

A countermeasure program against the Threat Active Protection System (APS) would be extremely valuable to all of the medium/heavy antitank missiles.

Impact/Utility to the Army. This study highlights the need to continue modernization to match and exceed Threat capabilities. Specifically, it provides analytical support to the US Army Infantry School's AAWS-H family concept.

Main Assumptions. The two main assumptions were the level to the Threat forces will modernize and that Blue and Threat systems will meet postulated performance characteristics.

Principal Limitations. The principle limitation was the requirement to complete the analysis within 5 weeks. This restricted the TRADOC Analysis Center-White Sands Missile Range (TRAC-WSMR) to utilizing scenarios that were available and ready for production with minimal effort, fully aware that some of the scenarios were under revision but that the revisions would not be available in time to be included in the analysis.

Scope. To ensure that the analysis was relevant, the analysis examined heavy and light Blue forces in both Southwest Asia (SWA) and Northeast Asia (NEA) theaters using offensive and defensive scenarios. Three families of Blue alternatives and two levels of Threat were analyzed.

Approach.

The strategy for developing the study alternatives and levels of Threat was very straightforward. The beginning building block was the list of systems that deployed for Desert Storm. The study participants then looked to see what decisions had been made to upgrade systems projected to be available for a near-term conflict, and then looked "over the horizon" at courses of action and possible decisions that could be made in the near future to further increase the force's lethality and survivability. This resulted in a near-term, mid-term, and objective alternative. (The mid-term alternative without AMS-H) was used to address the issue of follow-on-to-TOW).

The near-term family reflects those systems expected to be in the force by 1999. This included the Javelin, TOW 2B with ITAS (high mobility multipurpose wheeled vehicle (HMMWV)), Armored Gun System (AGS) with M1 TIS and level 3 armor, M1A1 tank, M2A2 Bradley fighting vehicle (BFV) (TOW 2B with AN-TAS 4), AH-64 Apache attack helicopter with Hellfire semiactive laser (SAL), and dual purpose improved conventional munitions (DPICM) artillery munitions.

The mid-term family reflects those systems that would be fielded in sufficient quantities by 2005-2010 to fully equip initial deploying forces. This included the Javelin, AMS-H with ITAS (HMMWV), AGS with HTI forward looking infrared (FLIR) and level 3 armor, M1A2 tank, M2A3 BFV (AMS-H with IBAS), AH-64 Apache with Longbow (LB)/Hellfire millimeter wave (MMW)/SAL, and DPICM/155mm search and destroy armor munition (SADARM) artillery munitions.

The objective family added LOSAT and EFOG-M to the mid-term family and possibly equates to the upper edge of the 2005-2010 window.

Two levels of Threat were considered, a near-term and a future Threat. In the SWA scenarios, the near-term Threat assumed a T72S as the main battle tank and a BMP-2 as the principle armored personnel carrier (APC). Both the T72S and the BMP-2 were equipped with FLIRs. Additionally, in one of the scenarios (high resolution scenario (HRS) 29), command tanks (platoon leader and above) were equipped with APS, laser warning receiver (LWR) systems firing multispectrum smoke, and radar warning receiver (RWR) systems also firing multispectrum smoke. The NEA scenarios assume the T72M1 as the main battle tank and the M1973 APC as the principle armored personnel carrier. No FLIRs were played in the NEA scenarios.

The future Threat assumed that the T72S tanks in the SWA scenarios were upgraded to the T80U with explosive reactive armor (ERA), the BMP-2s were upgraded to BMP-3s, and SADARM type artillery munitions were available. Command tanks and BMPs (platoon leaders and above) were equipped with an improved APS while all others were equipped with the near-term APS. In the NEA scenarios, the T72M1 tank was upgraded with FLIR, ERA, LWR, and RWR. Both the LWR and RWR fired bispectrum smoke. Additionally, the Threat artillery was given SADARM-type munitions.

The analysis utilized two SWA and two NEA HRS. Three of the scenarios were modeled in the Combined Arms and Support Task Force Evaluation Model (CASTFOREM) and one scenario (HRS 43) was modeled in Janus.

Study Sponsor. Headquarters, TRADOC, Fort Monroe, VA 23651

Performing Organization. TRADOC Analysis Center-White Sands Missile Range, White Sands Missile Range, NM 88002 (POC: MAJ Stephen J. Powell, DSN 258-2802/4300)

DTIC Accession Number. DA 358602

1. **STUDY TITLE.** Class IV Planning Factors

2. **STUDY PURPOSE.** The purpose of this work was to derive and validate new Class IV supply planning factors appropriate for updating the Army Force Planning Data and Assumptions used for the Total Army Analysis and for supporting contingency planning and analysis at the division level or higher.

3. **CRITICAL ISSUES ADDRESSED.** This study supports the redesign of the Army as well as its sustainment by providing a validated Class IV planning factor suitable for multiple contingencies.

4. **OBJECTIVE.** The Class IV planning factor has been 8.5 pounds per person per day for more than 20 years, with little documentation existing to show how the number was derived. The variety of contingencies currently being planned suggests that a single number is not sufficient. The study's product is, therefore, an algorithm for computing a Class IV planning factor suitable for each given set of contingency conditions.

5. **PRINCIPAL FINDINGS.**

a. The Class IV consumption rate varies not only from contingency to contingency but also across the different phases of a single contingency. A single planning factor cannot accurately represent the Class IV requirements of the variety of contingencies currently being planned and analyzed.

b. The Class IV requirement is most dependent upon the type of forces deployed (heavy or light), the threat's capabilities, the force deployment rate, the force movement rate, and the percent of the LOC/facility requirement met by the existing infrastructure or through the use of host nation or contractor resources.

c. The results of a detailed calculation of the Class IV consumption rates for Europe, Major Regional Contingency-West (MRCW), and Major Regional Contingency-East (MRCE) as determined by the scenario data used for the FASTALS model in support of TAA-2001 are shown below:

CONSUMPTION RATES (LB/PERSON/DAY)	EUROPE	MRCW	MRCE
Overall Average Class IV Consumption Rate	19.65	15.90	22.35
Base Development	3.71	5.86	10.61
Barrier/Fortification	15.94	10.04	11.73

6. **IMPACT OF THIS EFFORT.** This study provides a good, quick estimate of the Class IV supply requirements for a given contingency which is crucial to high-level military planning and analysis, including the Army's force structure studies conducted under the TAA program and contingency planning using guides such as FM 101-10-1/2.

7. MAIN ASSUMPTIONS. The basic assumptions of the study are that the derived planning factor: (1) represents a "minimal requirement", unconstrained by engineer or logistic capabilities; (2) includes only construction tasks that are generally planned and executed; (3) excludes locally-procured materials (coarse and fine aggregate, mineral fill, etc.); (4) assumes ideal terrain and climate/weather conditions; (5) includes only materials moving through the military supply system: and (6) excludes construction requirements met by host nation or contractor support.

8. LIMITATIONS. The Class IV consumption rate provided is a planning factor, and should not be used to estimate Class IV requirements at lower than the division level.

9. SCOPE. The Class IV supply category includes fortification materials, obstacles and barrier materials, and construction materials for base development and general engineering. This study provides a method for computing a good estimate of a specific contingency's Class IV requirement (in pounds per soldier per day) given a few generally known conditions regarding the forces to be deployed, the enemy's capabilities, and the theater's infrastructure.

10. APPROACH. This study approached the problem in two phases:

a. The first phase concentrated on deriving planning factors for each of several well-studied contingencies and relied on the existence of sufficient data to actually calculate the Class IV supply requirement for each contingency. This approach provided a firm set of beginning numbers that were studied and refined by subject matter experts - engineer planning staffs at the corps and Engineer Command level. This phase was confined to the known contingencies used for the TAA-2001 studies.

b. The second phase of the work focused on developing a simple algorithm for computing a contingency-specific planning factor from a given set of generally-known conditions, such as the number and type of units deployed, the level of the theaters existing infrastructure, and the relative capabilities of the threat. This phase used findings from the first phase as a starting point, input of subject matter experts, and records from Operation Desert Storm.

11. STUDY SPONSOR. U.S. Army CASCOM, Mr. Alex Blair.

12. PERFORMING ORGANIZATION AND PRINCIPAL AUTHORS. This study was conducted for TRADOC and the U.S. Army Engineer School by the U.S. Army Construction Engineering Research Laboratories (USACERL). Ms. Carol Subick (USACERL) was the principal investigator for the study. Mr. Mark Premont (USAES) was the technical monitor for the study, DSN 676-5468, commercial (314) 563-4084.

13. LITERATURE SEARCH. A literature search was done through DTIC, in addition to reviewing in-house files to ensure similar work had not already been conducted.

14. DTIC ACCESSION NUMBER. ADA294539

15. START AND COMPLETION DATES. Oct 93 - Mar 95

Combined Forces Command (CFC) Decision Support Modeling (DSM) 0, I, II, III, and IV.	STUDY SUMMARY CAA-MR-95-1, CAA-MR-95-2, and CAA-MR-95-53

1. STUDY TITLE. Combined Forces Command (CFC) Decision Support Modeling (DSM) 0, I, II, III, and IV.

2. STUDY PURPOSE. The DSM series of work was conducted from mid-1994 to December 1995 to assist the staff in the Joint Operation Planning and Execution System (JOPES) deliberate planning process. Specifically, this modeling supported the development of a contingency plan (CONPLAN) for the defense of the Republic of Korea (ROK) when Korea was the second of two major regional contingencies (MRCs). Later, the work was focused on building the Joint Strategic Capabilities Plan (JSCP).

3. CRITICAL ISSUES ADDRESSED. Each modeling effort involved a common thread: What was the impact of particular variables on a potential conflict in Korea in the near term? DSM I and III looked at issues involved with Korea as a single (only) MRC. DSM II and IV looked at issues involved with Korea as the second of two MRCs. Each of these studies had excursions to examine effects of various influences on the campaign such as north Korean (nK) attack scenarios, flexible deterrent options (FDOs), and force enhancements (FEs).

Terrain and seasonal weather characteristics, air operations (as planned by the air component command (ACC), Time-Phased Force Deployment Data (TPFDD) and reception, staging, onward movement, and integration (RSO&I) information, campaign concept of operation (CONOPS), order of battle for CFC and disposition of forces (DOF), nK forces and attack scenarios, and indicators and warning (I&W) assumptions are all built into the modeling effort.

4. OBJECTIVES. With so many planning factors and intelligence estimates to consider, modeling is very useful at showing the differences in campaign outcomes based on changes in assumptions and data. Modeling insights can confirm professional judgments or reveal additional aspects for consideration. Military and civilian decision makers have found computer simulations to be extremely helpful in reducing uncertainty and measuring risk, especially with regard to the best use of limited resources. The objectives of these efforts were, given a specific set of forces and assumptions (the JSCP), to determine and compare the campaign impact of the above critical issues addressed in terms of the following measures of effectiveness:

a. <u>Forward Edge of the Battle Area (FEBA) movement</u>. Defined as the rate and depth of an attacking force.

b. <u>Permanent System Losses and Kills</u>. Red and Blue losses.

c. <u>Casualties</u>. Red and blue personnel casualties.

d. <u>Commitment of the Reserves</u>. Timing and total requirement of Blue forces committed.

Also, the series of work was to explore the consequences of timelines, forces, and assumptions different from the current JSCP. (Focus was on building a new JSCP).

5. PRINCIPAL FINDINGS. The principal findings are arrived at through professional judgment and campaign outcomes. Principal findings include: campaign dimensions (the major turning points of the campaign based on operation plan (OPLAN) phases--nK attack halt, etc.), forward edge of the battle area (FEBA) movement, logistics demand for most major (III, V, VII) classes of supply, personnel casualties, equipment losses, and relative loss rates for nK versus CFC. Insights and findings are discussed in the classified study reports.

6. IMPACT/UTILITY OF THE STUDY. The Decision Support Modeling series of work (specifically, DSM I and II) was used to support USFK/PACOM/CENTCOM input to the JSCP. This series of analysis served as a basis for USFK's participation in the JCS Nimble Dancer series of wargames conducted from November 1994 through March 1995. DSM III was used to evaluate feasibility of revised CFC CONOPS and forces. DSM IV is being used to identify issues involved with current JSCP guidance impact on CFC OPLAN when Korea is the second of two MRCs.

7. MAIN ASSUMPTIONS. These are discussed in each of the classified study reports.

8. PRINCIPAL LIMITATIONS. These are discussed in each of the classified study reports.

9. SCOPE. The scope of the efforts included modeling single and dual MRC campaigns on the Korean peninsula. (Dual MRC refers to the case where Korea is the second of two MRCs.) The scope of the efforts is further defined in each of the classified study reports.

10. APPROACH. The primary analytic tool used was the Concepts Evaluation Model (CEM), a low-resolution, force-on-force, theater-level model. Inputs for this model include order of battle, disposition of forces, and scheme of maneuver for north Korean (nK), Republic of Korea (ROK), and US forces. Data for US reinforcing force arrivals were taken from the most current service maintenance Time-Phased Force Deployment Data (TPFDD). Movement of nK forces from assembly areas through staging areas into the battle was modeled using a network simulation (see CAA-MR-93-21, North Korean Military Centers of Gravity I, Operational Tempo (nK OPTEMPO)). The results of this simulation were introduced into the CEM. Air operations were modeled as described in Military Centers of Gravity II/III, Air Component Command (CAA-MR-93-20) using updated air forces' TPFDD, Pre-Integrated Tasking Order (ITO) plans, and sortie generation factors. The results of this precursor analysis were then introduced into the CEM. Intratheater movement of US ground reinforcing units was modeled using a network simulation model representing the reception, staging, onward movement, and integration (RSOI) network in Korea. This model estimates the time for a unit to move from port of debarkation (POD) to tactical assembly area (TAA). (This modeling is described in CAA-MR-94-23, Reception, Staging, Onward Movement, and Integration Operations(RSOI-O), May 1994.)

11. STUDY SPONSOR. Combined Forces Command (CFC), Deputy Chief of Staff, Plans and Policy (C-5).

12. PERFORMING ORGANIZATION AND PRINCIPAL AUTHORS. US Army Concepts Analysis Agency, Operational Capabilities Assessments -Northeast Asia (OCA-NEA), CSCA-NE, 8120 Woodmont Avenue, Bethesda, MD 20814-2797. Principal authors include LTC Patrick A. Guinnane, MAJ Paul T. Buhl, and CPT Ronald A. Rynne, DSN 295-5267, comm (301)295-5267.

13. LITERATURE SEARCH. A thorough search of the latest publications was used to include Department of Defense (DOD), Headquarters, United Nations Command/ROK-US Combined Forces Command (UNC/CFC), Headquarters, Air Component Command (ACC), UNC/CFC, Headquarters, Combined Marine Forces Command, Headquarters, US Forces, Korea, Department of the Air Force, Department of the Army, US Army Intelligence and Threat Analysis Center (ITAC), US Army Concepts Analysis Agency (CAA), and other publications.

14. DOCUMENTATION. Requests for documentation may be sent to the Director, US Army Concepts Analysis Agency, ATTN: CSCA-NE, 8120 Woodmont Avenue, Bethesda, Maryland 20814-2797. Document numbers: CAA-MR-95-1, CAA-MR-95-2, and CAA-MR-95-53.

15. START AND COMPLETION DATE. Series initiated July, 1994 and completed December, 1995.

CRUSADER

Independent Government Cost Estimate (IGCE) for Crusader

COL Ray Pawlicki, Crusader IGCE Chief
U.S. Army Research and Development Center

Mr. Morteza Anvari, Crusader IGCE Cost Chief
U.S. Army Cost and Economic Analysis Center

Mr. Michael A Niggel, Operations Manager
Mr. Michael J. Neuman, Team Chief
Mr. Leonard W. Ogborn, Deputy Team Chief
Science Applications International Corporation

Background Crusader will be the direct fire support "system of systems," providing direct and general support fires to maneuver forces on the future battlefield. In mid 1994, as the Crusader program was approaching the Demonstration/Validation (Dem/Val) Phase, the Army Acquisition Executive (AAE) decided that Crusader would be developed as a single system by a contractor team and that the development phase would be a sole-source acquisition. As a result, it became essential for the Program Manager's Office (PMO) to have an accurate, realistic and defensible cost estimate that could be used as the baseline for sole source negotiations. Consequently, an IGCE became the crucial tool needed by the Crusader program in order to negotiate a realistic contract cost.

Crusader was one of four programs which had been designated as an Army lead program for acquisition reform. This meant that the lessons learned from the Crusader IGCE process would provide a road map for acquisition streamlining and would help define IGCEs for major acquisitions in future years. The IGCE teams recognized that the resulting Crusader IGCE would not only provide the basis for the Army's cost position as it negotiated the Crusader developmental effort, but that the IGCE must also encompass the requirements of the Office of the Secretary of Defense (OSD) and Army acquisition reform initiatives.

The Crusader PMO had adopted an Integrated Product Team (IPT) approach to systems engineering management that matched the contractor's own IPT structure. The IGCE organization was configured similarly with the separate cost estimating teams being aligned with the PMO/contractor IPTs. One requirement was that the IGCE team remain independent from the PMO during the development of the cost estimate. Therefore, although meetings with the United Defense, Limited Partnership (UDLP) team engineers were essential to the IGCE team, the team recognized early on that the agenda for each meeting must be constrained to the products and approaches within each Work Breakdown Structure (WBS) element. Discussions of costs and levels of effort would be strictly prohibited. The IGCE would rely on other independent sources of information, such as government, private engineers and scientists, or information from previous development and production programs, for its cost and effort estimates.

The PMO had also requested that the Crusader IGCE process be recorded so as to provide a road map for future acquisitions. In addition to the estimate, the documentation had to include the IGCE approach and how it interfaced with the OSD, Army staff, the user community, the procurement community, and the contractor. Documentation was also required to chronicle all Crusader activities prior to the IGCE effort and the final report designed to serve as a reference for the Acquisition Corps. Any valuable perspectives that could contribute to a better understanding of the process by Project Managers, the AAE, the acquisition community, technical specialists, etc., were to be included in documentation.

The IGCE architects quickly recognized the need to accurately estimate the costs of each element of the work breakdown structure and to mirror the distinct management and accounting practices of the contractor team. They also foresaw that the IGCE would need to be developed in parallel, and concurrent with, the contractors' detailed technical and cost proposals while the IGCE process and product must remain flexible, dynamic, and responsive to evolving design and management concepts.

To meet the IGCE's anticipated requirements, to provide an electronic global structure and configuration control for the estimates, and to allow for decentralized operation by each member of the IGCE team, an Information Architecture Structure (IAS) was developed. The IAS addressed the operational mode of the IGCE organization, the contractors' WBSs, and the programmatic needs of the PMO, the Army, and OSD. By fully linking all files and information, such as contractor rates, WBSs, labor categories, etc., to the estimate and documentation, the IAS provided direction and assistance and facilitated review of the estimating team's independent efforts, while enabling the costing of the estimate at the component level. Not only did the IAS explicitly document the estimate, but it provided the visibility and functionality needed to support the PMO management studies and decision processes.

Once the official IGCE was completed, the IGCE team worked with the PMO's negotiating team to familiarize negotiators with all the rationale behind the IGCE. The team also worked with the Procurement Contracting Office (PCO) in a continuing effort to tailor the costing model in a manner that would provide optimum support for negotiations.

The IGCE Results Three separate IGCEs were necessary for each phase of the Dem/Val effort. These were a Requirements Analysis/Component Maturation (RA/CM) phase, RA/CM Extension phase, and the primary Dem/Val phase.

The RA/CM IGCE was delivered to the PMO on 14 November 1994. The initial Dem/Val IGCE was presented to the AAE on 16 March 1995. He approved both the IGCE process and the initial findings. The IGCE for RA/CM was delivered to the PMO on 31 March 1995, as adjustments in the schedule and structure of the program steadily evolved. The estimate and model were refined to capture new information and an improved understanding of the programs obtained since November. A sensitivity analysis strengthened the PMO's negotiating position. The final Dem/Val IGCE was presented to the Program Executive Officer for Field Artillery Systems on 17 August 1995.

The IAS enabled the delivery of all of the above products. The detailed documentation of the estimate and the comprehensive costing model have provided an outstanding baseline and tool for negotiating the contract work. The Crusader IGCE contained 444 hardware and software WBS elements as well as the systems engineering and integration levels of effort at the subsystem and system levels. Because the documentation and the estimate were linked to the costing section, the estimated cost responded quickly to all labor and material adjustments. The model's flexibility also supported changes in the contractor teaming arrangement, WBS, cost structure, and rates, enabling the IGCE to become the working baseline for the negotiations.

The Crusader PMO at Picatinny Arsenal, New Jersey, and the U.S. Army CEAC in Falls Church, Virginia, co-sponsored and performed the IGCE with support from Science Applications International Corporation. Although the full model was developed in Excel, an abridged version of the model was completed using the Automated Cost Estimating Integrated Tools (ACEIT) suite. Copies of both the Excel and the ACEIT models reside at the U.S. Army Cost and Economic Analysis Center (CEAC) and at the Crusader PMO. The Crusader IGCE process concluded on 30 November 1995, when negotiations for the primary Dem/Val phase were fully underway.

Benefits To The Army The IGCE product has provided immediate and substantial benefits to the Crusader program. Acceptance of the IGCE, in lieu of the Business Clearance Memorandum, saved an estimated 5 months in the contracting schedule. The PMO has concluded that the detail and accuracy of the IGCE gave their negotiation team a well-documented, responsive tool and a level of understanding of, and confidence in, their negotiating position that has resulted in significant cost savings. While the PMO can use the exceptionally detailed rationale of the IGCE as its negotiating baseline, the PCO can use the cost estimating model to perform real-time costing as negotiations proceed.

The Army and the Department of Defense acquisition community now have a fully documented case study of a state-of-the-art major item acquisition. Knowledge of the context, actions, and lessons learned can be adapted to future programs. The approach for this IGCE process was designed to capture the spirit of the Army acquisition reform initiatives.

The development of the estimate involved fundamental engineering, scientific and mathematical processes based on the best technical source data available. The cost estimating process followed the DA *Cost and Economic Analysis Manuals*. Classic OSD systems' engineering practices served as guidelines in building the estimate. Documentation was thorough, while the costing model reflected actual cost accounting practices, burdens, labor rates, and teaming agreements.

Final Reports The Crusader IGCE contains contractors' proprietary data and is classified "For Official Use Only." The documentation of the Crusader IGCE process was published as a report entitled *Acquisition Streamlining and Lessons Learned Report for Crusader*. The 200-page document covers essentially every aspect of the Crusader acquisition. It includes lessons learned that are of relevance to both the Crusader program and to future acquisitions. This report is available from Defense Technical Information Center (DTIC), catalog number ADA-305127.

Longbow Milestone III Cost and Operational Effectiveness Analysis (COEA)

Study Gist

Study Purpose. The study purpose was to provide a COEA update of the Longbow Apache System in support of a Headquarters, Department of the Army (HQDA) Milestone III decision scheduled for first quarter fiscal year (FY) 1996.

Critical Issues Addressed. HQDA tasked Training and Doctrine Command (TRADOC) Analysis Center-White Sands Missile Range (TRAC-WSMR) to determine the operational effectiveness of each alternative performing deep missions in the day or at night, in battlefield reduced visibility, and under adverse weather conditions, as well as the cost and supportability of each alternative. The final critical issue was the "crosswalk" comparison of the initial operational test and evaluation (IOTE) with the COEA results using the Combined Arms and Support Task Force Evaluation Model (CASTFOREM) combat model.

Objectives

Determine the operational effectiveness of each alternative.

Determine the strategic deployability of each alternative.

Determine the cost of each alternative.

Determine the logistics, training, and manpower impacts for each alternative.

Determine the additional cost and value of having a dedicated air-to-air missile on the Longbow Apache helicopter.

Secondary objectives included an evaluation of the sustainability in extended combat and a crosswalk comparison of the IOTE to the COEA results.

Principal Findings

The performance analysis results indicated that the Longbow Apache System provides a significant increase in performance over the AH-64A+.

The operational effectiveness analysis (OEA) results showed that the introduction of the Longbow Apache System capabilities into the heavy attack helicopter forces significantly increases force effectiveness in both clear day/night and adverse weather conditions over that of the AH-64A+.

The OEA results showed that the Comanche scouts and Longbow Apache helicopter forces with fire control radar (FCR) are the most effective alternative, followed by the Longbow Apache with full FCR equipment, the Longbow Apache partially equipped with FCR, the AH-64A+, and lastly the OH-58D Kiowa Warrior.

The OEA results showed that the Longbow System provides improved survivability for attack helicopter battalions, as well as for the overall Blue force.

The OEA results showed that the Longbow System has the capability to operate in adverse weather without a significant reduction in effectiveness.

The OEA results showed that the Longbow System improves the flow of information on the battlefield.

The cost analysis results showed that the acquisition of an Apache fleet of 758 AH-64D with 227 and RF Hellfire missiles will cost $9.1B more than the base case AH-64A+ helicopters whose base cost is $19.6B.

The logistics analysis results indicated only small differences in the alternative systems.

The logistics analysis results indicated no strategic deployability problems with the alternatives. An actual C-5 loading test is scheduled for Longbow Apache in October 1996.

The manpower analysis results concluded that the Longbow Apache required 3 to 4 percent fewer direct

maintainers than the AH-64A+. Other personnel categories remain constant.

The training analysis results indicated that the introduction of the Longbow Apache system would result in the consolidation of two maintenance military occupational specialties (MOS) and would require a small increase in training time for operators and maintainers.

The IOTE to COEA crosswalk analysis indicated a relatively high level of consistency between the IOTE and COEA trend results.

Impact on the Army. This study directly supported the Milestone III Department of Defense (DOD) production decision reached in October 1995. The study results had tactical, operational, and fiscal implications. By looking at the critical issues, HQDA was able to make an informed decision on whether to spend an additional $9B on the AH-64 A+ Apache helicopter fleet. The "crosswalk" between the high resolution combat model at TRAC-WSMR and the IOTE served as an important comparison between combat modeling and actual field testing.

Main Assumptions. The developmental systems and munitions represented was fielded as scheduled and met the postulated performance characteristics. Also, the proposed force structures were viable options and the postulated Threat was representative of that expected in the year 2004.

Principal Limitation. A Comanche sensor fusion process was implicitly modeled to capture the ability of the FCR and the 2nd generation forward looking infrared (FLIR), working together, to provide a reduction in FCR-generated false targets for the attack helicopter team.

Scope

The OEA was addressed by examining the alternative helicopter forces within three high resolution scenarios which focused at the brigade/battalion level and two low resolution scenarios which looked at the corps/division level. The scenarios tested the ability of each helicopter to operate deep and acquire and engage stationary and moving targets in reduced visibility, at night, in battlefield obscurants, and under adverse weather conditions. The scenarios also involved heavy and light forces, scout and attack missions, and various levels of air defense threats.

The strategic deployability was examined by TRADOC Analysis Center-Fort Lee (TRAC-LEE) and the Military Traffic Management Command which compared the deployability of the AH-64A+ and the Longbow Apache using either sea or air assets.

The logistics impact analysis (LIA) and manpower requirements analysis conducted at TRAC-LEE determined the maintenance and personnel burdens associated with each alternative. The training impact analysis (TIA) looked at training and training devices.

The crosswalk analysis compared the IOTE results with the COEA results using the CASTFOREM combat model.

The Longbow performance and sustainability analyses were conducted by the Army Materiel Systems Analysis Activity (AMSAA). The first analysis compared the performance of the Longbow Apache with FCR to that of the AH-64A+. These performance parameters were then used in the operational effectiveness analyses. The second analysis examined the sustainability of the Longbow Apache with FCR and the AH-64A+ helicopter forces in multiple day combat campaigns.

Approach. The basic approach of the study was to represent the alternative helicopters in representative force-on-force scenarios to determine their force and system operational effectiveness. The costs of the alternatives were considered a major part of this analysis. Supporting analytical agencies provided the analyses to address issues related performance, logistics, manpower, training, sustainability, and operational testing.

Study Sponsor. The study sponsors were Department of the Army, Office of the Deputy Chief of Staff, Operations and Plans (DCSOPS), and Office of the Assistant Secretary of the Army (Research Development and Acquisition) (SARDA).

Performing Organization. TRADOC Analysis Center - White Sands Missile Range, NM 88002-5502 (Study Director: Mr. Roy Willoughby, DSN 258-4631)

DTIC Accession Number. DA 358600

Palletized Load System:
An Analysis of Alternative Flatrack Acquisition Strategies

1. **STUDY TITLE.** Palletized Load System: an Analysis of Alternative Flatrack Acquisition Strategies

2. **STUDY PURPOSE**. A key element of the Army's battlefield distribution system of the future is the Palletized Load System (PLS), comprised of highly mobile trucks, trailers, and flatracks. Demountable flatracks are used to quickly pick up and drop off loads of ammunition from trucks and trailers using a load handling system installed on the truck. This system speeds the delivery of ammunition to artillery units and reduces handling and congestion in forward areas.

The fielded flatrack (called an "A-frame flatrack" because of the shape of its fixed endwall) meets requirements for ammunition distribution operations forward of the Corps Storage Area (CSA). However, the A-frame design is not intermodal; that is, it cannot be stacked in a container cell of a containership to deliver loads of ammunition from CONUS to a theater of operations. This intermodal capability is of increasing importance in supporting a CONUS-based force, which must rapidly deploy to widespread contingency areas. The Army has designed an enhanced flatrack (designated M1) with two endwalls that is expected to perform as an intermodal container and as a PLS flatrack within the corps area.

To meet both user battlefield requirements and intermodal specifications, the weight, complexity, and cost of the intermodal flatrack is significantly greater than the A-frame flatrack. Acquisition costs for the intermodal flatrack are projected to be more than double the costs of the A-frame flatrack. At the same time, emerging needs to operate in two near simultaneous MRCs have expanded Army-wide flatrack requirements to 50,848. The combination of high individual flatrack costs and substantial flatrack requirements carries an unaffordable price tag given today's constrained fiscal environment. LMI was asked to assess the costs and benefits of flatrack alternatives and to recommend the most cost-effective mix of flatracks.

3. **CRITICAL ISSUE ADDRESSED**. This study addressed the critical issue of logistical support for force projection and strategic distribution at low cost.

4. **OBJECTIVES.**

(1) Identify alternatives for providing PLS intermodal capability.
(2) Identify the operational effectiveness of each alternative.
(3) Identify the relevant costs of each alternative.
(4) Determine a production/buy quantity of each flatrack alternative.
(5) Evaluate the costs vis-a-vis selected measures of effectiveness.
(6) Identify unresolved policy or doctrinal issues.
(7) Recommend an Army approach to provide a PLS intermodal capability.

5. **PRINCIPAL FINDINGS**

(1) Alternatives built around the intermodal (M1) flatrack are more costly than alternatives built around all the other flatrack options.

(2) Providing an intermodal capability by modifying the relatively few Palletized Load System (PLS) trucks to accept a broader range of flatrack alternatives would require fewer investment funds than generating the same capability through the purchase of M1 flatracks.

(3) Modification of the PLS Load Handling System (LHS) capability to lift any International Organization for Standardization (ISO) container or flatrack would add to the flexibility of the PLS as a distribution platform and a mobility asset. Until this redesign can be effected, detachable Container Handling Devices (CHD) can be used as an interim measure.

(4) Because the Army flatrack requirements far exceed the number currently under contract, the production of A-frame flatracks should continue until a final decision is made and production of an intermodal capability flatrack can begin.

(5) The use of commercially designed and competitively produced ISO sideless containers, with a CHD or modified LHS, offers significant cost savings ($160 million) over the purchase of M1 PLS flatracks. These commercial containers should be thoroughly tested before a final decision on the production of a PLS specific intermodal design is made.

(6) By investing in a modified LHS and a less expensive intermodal flatrack, congressional guidance can be met, unfunded requirements can be reduced, and PLS system operational capabilities can be enhanced for current and future uses.

6. **IMPACT/UTILITY TO THE ARMY.** The study led to an Army decision to redesign the intermodal flatrack and reduce the number acquired. As recommended by the study, commercial industry is participating in the development of less expensive alternative flatrack designs and these designs are being tested to assess their combat effectiveness. If these new designs are acceptable, the Army can acquire flatracks at 60% of the cost of the original intermodal design and avoid spending over $160 million to meet the flatrack requirements of one MRC.

7. **MAIN ASSUMPTIONS.**

(1) The scenarios used in this study are representative of likely major regional contingency (MRC) deployments.

(2) The performance specifications and designs of flatrack alternatives closely approximate the final design characteristics of produced equipment.

(3) The acqusition, operating, and support costs of flatracks evaluated will fall within the estimated range of costs.

(4) The total Army requirement for flatracks or container-compatible alternatives and PLS trucks and trailers will continue to exceed the requirement of one MRC.

(5) Ammunition distribution on the battlefield will continue to follow the principles described in TRADOC Pamphlet 525-65 Maneuver Oriented Ammunition Distribution System-PLS (MOADS-PLS).

8. **PRINCIPAL LIMITATIONS.** The focus of the simulation was battlefield distribution requirements from the corps storage area (CSA) forward; strategic distribution from ammunition distribution depots to the CSA was not simulated but was subjectively assessed.

9. **SCOPE.** PLS intermodal and other flatrack acquisition alternatives, to include adaptations of commercial designs, modifications to the load handling system of the PLS truck, and containers, were identified. Subjective and objective evaluation criteria were described and then applied to each of the alternative designs. A simulation of the MRC battlefield distribution system was developed and used to examine the performance of flatrack alternatives. Relevant costs were identified and compared to benefits to recommend the most operationally and cost- effective mix of flatracks. Implementation of the recommendations forwarded with this study could avoid unnecessary costs of over $160 million, increase the payload of battlefield flatracks, and provide an intermodal distribution capability.

10. **APPROACH.** Potential flatrack equipment alternatives that were both containership compatible and could operate with the PLS were identified. The costs and performance characteristics of each alternative were developed from available engineering data, cost estimates and field trials. A simulation of battlefield distribution under MOADS-PLS doctrine was developed and used to determine the fleet size required for each flatrack alternative to meet

MRC ammunition demands. A large decision tree of potential flatrack alternatives, PLS truck modifications, and sustainment containers was developed. Each combination of options was compared by applying subjective and objective performance measures and feasible alternatives were identified. The relative benefits and costs of each feasible alternative were considered and the most operationally and cost- effective alternative was recommended. We then provided the following specific recommendations for the Army to equip the force with an intermodal capability at reasonable cost:

(1) Continue to produce A-Frames at a rate of 200 per month while pursuing engineering of the modified PLS LHS and investigating the compatibility and feasibility of meeting PLS system needs with ISO commercial sideless containers and modified LHS.

(2) If investigation results are positive, purchase 15,211 ISO commercial sideless containers, 11,130 A-Frames, and modify 2,678 PLS truck LHSs. If negative, purchase flatracks of modified AMCON or M1 design to fill out user requirements and modify 1,282 PLS truck LHSs.

(3) Do not "switch over" production to M1 flatracks until their design, performance, and costs have been fully examined, tested, and accepted by the user community.

(4) Perform user acceptance testing of flatracks, the modified PLS LHS and the CHD before moving into acquisition and/or production.

(5) Establish a PLS steering group.

(6) Develop and communicate to Congress a competitive flatrack procurement plan that will meet intermodal requirements.

(7) Clarify the policies and doctrine for ammunition movement through intermodal moves, distribution from port to Corps area, and from the CSA forward.

11. **STUDY SPONSOR.**

Director, Transportation, Energy and Troop Support (ATTN: Mrs. Norma Coffey)
Office of the Deputy Chief of Staff for Logistics
Headquarters, Department of the Army
The Pentagon
Washington, D.C. 20310

12. **PERFORMING ORGANIZATION AND PRINCIPAL AUTHORS.**

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13. **LITERATURE SEARCH.** This was a study of emerging and evolving logistical support and tactical distribution systems designed to support new concepts of force deployment with developmental equipment. We discussed the support concepts, equipment designs,and cost data with the Army points of contact to ensure that the study accurately represented emerging doctrine and planning. Our search of DTIC and civilian logistics data bases identified no other study that had been performed for these study objectives.

14. **DTIC ACCESSION NUMBER.** ADA-306570

15. **START AND COMPLETION DATES.** OCT 1993-SEP 1995

RAND Arroyo Center	Personnel Planning for Reserve Force Readiness	Study Gist

STUDY PURPOSE: To meet deployment requirements, RC units activated for Operations Desert Shield/Storm (ODS/S) needed to draw significant numbers of personnel from other units. Given the continued reliance on the RC in wartime, the personnel readiness shortfalls of ODS/S prompt concerns. Will the Army be able to deploy critical RC units at the required strength and timetables, and what policies will best enhance readiness and remedy emerging shortfalls?

CRITICAL ISSUES ADDRESSED: Wartime cross-leveling may become more difficult than during ODS/S. Current plans would deploy almost twice as many people in the first sixty days, in part because of AC reductions. Corresponding RC reductions further exacerbate the problem. How can the Army best ensure RC personnel readiness in peacetime while controlling both costs and demands on the training system?

OBJECTIVES: This project aimed to provide the Army a better understanding of Army RC enlisted personnel readiness shortfalls, their implications, and their potential solutions.

PRINCIPAL FINDINGS:

The typical Army RC unit activated for ODS/S had only 63% of its positions filled with soldiers qualified in their Duty Military Occupational Specialty (DMOSQ); it received almost 20% of the personnel deploying with the unit through cross-leveling. Furthermore, the problem continues.

We designed a future force and built a model simulating personnel actions during mobilization. Unrestricted, rapid cross-leveling for all activated units addresses most personnel readiness shortfalls. However, a more reasonable cross-leveling plan—i.e., deployability without reliance on cross-leveling for units deploying within the first 30 days (C+30)—tells a different story. In the Southwest Asia (SWA) scenario, for example, 25% of the units required to deploy within C+30 fall short of the 85% DMOSQ goal. Nearly two-thirds of these units fail to meet C-3.

The best way to reduce the need for cross-leveling and improve deployability is to reduce personnel turnover, i.e., job changes and attrition.

Earlier research and legislative efforts have focused on two possible causes of personnel readiness shortfalls in the Army RC: (1) failure to use Active Component (AC) experience and (2) high rates of personnel turnover. Our readiness modeling indicates, however, that increasing use of prior service personnel would have little effect on eliminating such shortfalls: Total accession requirements remain relatively constant; prior active accessions into mismatched MOSs must be traded for returning reservists qualified in those MOSs; and many of the DMOSQ prior active personnel subsequently separate from the RC or change jobs. For similar reasons, improving the RC DMOS to AC MOS match rate of prospective prior active service accessions by half (from 65 to nearly 100%) only enhances readiness somewhat.

Reducing personnel turnover offers considerably greater potential. Reducing job turbulence by half increases the DMOSQ rate by 9% and the job experience level by about 40%. Training load also experiences a large reduction—about 20%—because reducing job changes correspondingly reduces MOS reclassification training. Lowering attrition also has positive effects on DMOSQ rates and training loads, and in addition, on accession requirements. Reducing total turnover (job changes and attrition) sums the effects of reducing both types of problems because each lowers readiness and increases training requirements (or accession requirements) for different reasons.

Bonuses can reduce turnover, and jointly reducing attrition and job changes offers the greatest potential benefits.

Reducing reserve attrition should lead to substantial cost savings in lower recruiting and training costs. However, it would incur considerable outlays due to the required payment of incentives. Reducing job turbulence also requires incentives, but the compensation required is likely to be much less than that to reduce attrition. Consequently, a bonus to reduce attrition could also reduce turbulence if made contingent on staying in the same job. An advantage of a job turbulence-reduction bonus is that the policy may not cost anything, because the savings in training costs would outweigh costs of the bonus. But the turbulence-only approach also has a drawback: Many units need more improvement in their DMOSQ rate than the 9% provided by turbulence reduction to reach their readiness targets. We can accomplish this by jointly tackling attrition and job turbulence. A bonus large enough to reduce attrition by 25% should still be large enough to reduce job turbulence by 50%. The analysis suggests this policy could be quite beneficial and may actually result in net savings.

For units unable to mobilize at the targeted DMOSQ level, a bonus to reduce job turbulence by half could be employed when the required improvement in the DMOSQ rate is below 10%; the larger bonus designed to reduce attrition by 25% and job turbulence by half could be used when the needed DMOSQ improvement is 10% or greater. In the SWA scenario, this policy could cut the number of units below C-3 at their prescribed deployment time by almost 40% while tripling the number at C-1 to C-2. The estimated cost to the Army ranges from $2.2 million to a net savings of $4.0 million.

IMPACT/UTILITY FOR THE ARMY: This research identifies personnel policies that promise to enhance significantly RC personnel readiness and unit deployability at limited or no cost. In some cases, the personnel turnover-reduction policies may save the Army money while enhancing readiness. Moreover, the policies will substantially reduce the annual RC training and recruiting loads.

MAIN ASSUMPTIONS: To avoid overstating shortfalls, the mobilization and cross-leveling model assumes a force structure that contains every SRC called for in the two-MRC scenario according to the Mobility Requirements Study and a pool of like SRCs to draw from for cross-leveling. This provides an optimistic view of readiness levels. The readiness enhancement model—developed to compare alternative personnel policies—assumes a preference for recruiting DMOSQ soldiers and (second priority) prior service soldiers. Major changes in future endstrengths, recruiting preferences, or turnover rates, while unlikely, could affect the job qualification/experience levels and accession/training requirements estimated for alternative personnel policies. Savings estimates for reduced recruiting and training loads are based on bodies of evidence. The evidence underlying the cost estimate for the attrition-reduction bonus is more limited; the job turbulence-reduction bonus cost estimate is based on offsetting the dollar value of promotion to the next-higher grade.

PRINCIPAL LIMITATIONS: The evidence concerning the effect of pay on retention is dated and could overstate the size of the bonuses required to reduce attrition. More recent evidence emerging from the Army's bonus programs suggests greater responsiveness to such incentives. The job turbulence-reduction bonus required for soldiers who change jobs for reasons other than promotion opportunity is uncertain, and could be larger or smaller than the bonuses assumed in the research for promotion-related changes, depending on the soldier's motivation to remain in the RC.

SCOPE: This project examined the extent of cross-leveling during ODS/S, the reasons for it, the likelihood of serious personnel shortfalls in future deployments, and, based on these findings, the types of policies that could best enhance the RC's readiness to deal with future contingencies.

APPROACH: We began with SMEs' reports of the cross-leveling actions taken during ODS/S. We then conducted a quantitative analysis of a comprehensive database on cross-leveling actions obtained from the Defense Manpower Data Center. To characterize the future ramifications of the shortfalls underlying cross-leveling, we constructed and ran a model of the mobilization and cross-leveling process for three deployment scenarios. For this modeling, we constructed an ideal future force structure perfectly matched to the requirements of the two-MRC scenario. To raise DMOSQ rates to the targeted levels, the model first optimized the DMOS assignments of personnel within an activated unit and then, time permitting, filled positions through training and cross-leveling actions. We modeled two mobilization plans for each scenario. The first relied on unrestricted cross-leveling for all activated units. The second did not rely on cross-leveling into units that had to deploy within the first 30 days.

To analyze the ability of policy alternatives to enhance peacetime RC personnel readiness and increase deployability, we built and ran a second model to compare two principal policy approaches: (1) improving utilization of active-duty experience within the RC and (2) reducing personnel turnover.

Potential costs and savings were calculated in two steps. First, we reviewed the relevant literature and programs to estimate the marginal costs of policies to enhance readiness and the marginal savings from reduced recruiting and training loads for the Army RC. Second, we used these marginal costs and savings as inputs to the readiness enhancement model, which determined the total costs incurred to enhance readiness under alternative policies and compared them with the savings resulting from reductions in annual accession and training requirements.

STUDY SPONSOR: Deputy Chief of Staff for Personnel, U.S. Army.

PERFORMING ORGANIZATION AND PRINCIPAL AUTHORS:

RAND, 1700 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138,
Phone: 310-393-0411; Bruce R. Orvis, Herbert J. Shukiar, Michael G. Mattock.

LITERATURE SEARCH: One line of prior work discussed the low prior-service content of the Army RC, MOS mismatch problems for soldiers entering the RC from active duty, and the high rates of personnel turnover within the Army RC (including their deleterious effects on peacetime DMOSQ levels). A second examined the potential benefits of retention incentives. The current research is unique in quantifying the extent and causes of personnel readiness shortfalls in a recent MRC (ODS/S); modeling likely shortfalls in future contingencies; assessing the benefits in DMOSQ levels and in reduced recruiting/training loads associated with alternative policies to enhance Army RC personnel readiness; estimating and comparing the potential costs and related savings of the most promising policies; and in integrating the findings to identify the most promising approach and its potential cost-benefit to the Army.

DTIC ACCESSION NUMBER: AD-D207627.

START AND COMPLETION DATES: FY93-FY95.

Prairie Warrior/Mobile Strike Force 1995 Advanced Warfighting Experiment (PW/MSF 95 AWE)

STUDY GIST

PURPOSE OF STUDY: The purpose of the study was to assess division-level design principles and operational concepts to inform Force XXI design decisions. The final report consisted of a scripted briefing and supporting annexes.

PRINCIPLE FINDINGS: Major implications were drawn from the analysis regarding systems or initiatives that are worthy of investment/implementation, initiatives which the analysis suggests should be discarded from further consideration, and systems/initiatives which the analysis suggests require further experimentation to make confident, informed decisions regarding Force XXI. For example, Army Battle Command Systems (ABCS) systems were identified in the invest/implement list, digitized battle staff was identified in the experiment list, and a paperless TOC was identified in the discard list.

MAIN ASSUMPTIONS:

1. Projected 2010 technological capabilities are valid.

2. Threat organizational, materiel, and doctrinal projections are sufficient to appropriately stress a 2010 MSF.

3. Scenarios used in analysis are representative of those for a Force XXI division.

SCOPE OF STUDY AND LIMITATIONS: The PW/MSF 95 AWE consisted of four independent but interrelated analyses -- the MSF Organizational and Operational (O&O) Analysis, MSF 95 Combat Service Support (CSS) Analysis, MSF Battle Command (BC) 95 Experiment, and the Operational Test and Evaluation Command (OPTEC) PW/MSF 95 AWE Assessment. In addition, the Joint Venture Combined Arms Assessment Team (JVCAAT) provided initial impressions from the PW exercise. All analyses evaluated an MSF equipped with 2010 technologies in a Northeast Asia scenario consistent with the starting conditions of the PW student exercise.

STUDY OBJECTIVES:

1. Assess MSF force design concepts using Force XXI design principles.

2. Assess MSF and Force XXI operational concepts.

3. Assess proposed division-level Force XXI BC capabilities and identify selected BC requirements.

4. Assess Force XXI CSS concepts, both internal and external.

BASIC APPROACH: The subordinate analyses of this AWE employed a variety of analytic processes, supported by both live and constructive simulation, to produce a series of analytic products which have been integrated into a single report.

1. The MSF O&O analysis used the Vector-In-Commander (VIC) analytic constructive model and a series of TRAC-developed force tailoring tools to develop Force XXI design implications with respect to tempo, lethality, and survivability. The Operations Other Than War (OOTW) analysis, as part of the MSF O&O analysis, examined the training and organizational requirements of the MSF in OOTW missions.

2. The MSF CSS analysis used the same VIC model runs (as used in the MSF O&O analysis) and questionnaires to develop Force XXI implications in the CSS area. The deployability analysis was conducted as part of the CSS analysis to determine closure profiles of the MSF from the Continental U.S. (CONUS) to the theater of operations.

3. The MSF BC experiment used a wide variety of analytic processes to support the analysis of BC issues for the Battle Command Battle Laboratory (BCBL). These processes included literature reviews, student questionnaires, exercise and training observations, and some limited analysis of output from the Corps Battle Simulation (CBS). This effort was supported by OPTEC. This experiment resulted in multiple assessments, to include individual addressal of digitization impacts across the doctrine, training, leader development, organization, materiel, and soldiers (DTLOMS).

4. The JVCAAT employed the standard Center for Army Lessons Learned (CALL) collection methodology during the PW exercise to develop a data base of observations. Observations were collected on issues identified by TRADOC battle labs and proponents.

STUDY SPONSOR: Battle Laboratory Integration Technology and Concepts Directorate (BLITCD), HQ TRADOC.

STUDY AGENCY: The TRADOC Analysis Center - Study Analysis Center (TRAC-SAC) was the lead analytical agency. Mr. Don Kroening served as study director for the integration effort of all the subordinate analyses. The subordinate analyses' study directors/team chiefs were:

1. COL Tom Brown served as team chief for the JVCAAT PW 95 Initial Impressions.

2. Mr. Tim Bailey served as the study director for the MSF 95 O&O Analysis.

3. Ms. Peggy Fratzel served as study director for the MSF BC 95 Experiment.

4. Mr. John Noble served as study director for the MSF 95 CSS Analysis.

5. LTC Scott Solon served as team chief for the OPTEC PW/MSF 95 AWE Assessment.

DTIC: ADB 207271

Reserve Component (RC) Mobile Close Combat Tactical Trainer (M-CCTT) Training Integration and Deployment Study

Study Gist

Study Purpose. To determine where best to station and route the M-CCTT fleet in order to provide the maximum training opportunity for RC units.

Objectives

As part of the RC M-CCTT Training Integration and Deployment Study, a need existed to determine where best to station and route the M-CCTT fleet so that they could provide the maximum training opportunity for RC units. In this study, three combinatorial optimization models are sequentially solved to decide where to station and then how to route the M-CCTT fleet.

The Close Combat Tactical Trainer (CCTT) allows units simulate military operations and tailor their training by selecting from a variety of different missions, environmental conditions, and opponents. These simulators will allow Army units to safely and realistically train collective tasks and achieve proficiency in tactical military operations, while reducing the amount of expensive field training and ammunition required to maintain training proficiency. The Army will field 21 mobile versions of the CCTT to infantry and armor RC forces. Each M-CCTT consists of three to five tractor trailer vans that carry simulators, computers and power supplies, a maintenance van, and a power-generator trailer.

The problem that this study addressed is important because the majority of RC units conduct monthly training on weekends at their local armories. Any travel time required to move to or from another training site directly detracts from their time available for effective training. In addition, RC units are widely distributed throughout the United States (US) in villages, towns and cities. Limited training time and dispersed units presents a difficult training challenge.

The Training and Doctrine Command (TRADOC) Systems Manager-Combined Arms Tactical Training, Fort Knox, KY and the Army National Guard Bureau, Washington, DC are responsible for M-CCTT fielding and management policy. The Army National Guard Bureau specified the armor and infantry units that required M-CCTT training and how the simulator should be used as part of a unit training strategy. They asked us to identify the best locations for the M-CCTT as part of the fielding plan for the simulators. An initial hand-analysis using a US map and concentric circles on transparent acetate did not yield an acceptable solution. Although the project scope only requested that a stationing analysis be conducted for the armor and infantry versions of the M-CCTT, we devised innovative vehicle routing models that insured that all units received the required amount of training while minimizing both the distance and number of moves that the unit and M-CCTT make each year.

Principal Findings. The intelligent routing of the M-CCTT fleet provides a significant cost savings over the currently proposed contractor logistics support (CLS) contract. The contract requires that each M-CCTT perform 44 moves per year at an average distance of 250 miles per move. This equates to a total of 11,000 miles per year per system. In contrast, our solution requires drastically fewer moves and miles; on average, each M-CCTT moves 12 times per year at an average of 151 miles per move. Since it was not possible to obtain the exact cost per mile to move a M-CCTT due to contract sensitivity, we parameterically compared our solution with the contract specifications. Using a conservative estimate of $10 per mile to transport a M-CCTT (3-5 tractor trailers and 2 support vehicles), the vehicle routing solution will yield a cost savings of more than $8.6 million per year. Over the 15 year life of the fleet, our solution will save approximately $100 million in operating

costs. In addition, a one-time cost savings, in excess of $3 million dollars, will be realized because only a subset of armories and local training areas will require M-CCTT facility upgrades (the original fielding plan proposed to emplace concrete housing pads and upgrade local power conditioning equipment at each armory). Finally, opportunity cost savings accrue due to the reduction in the routine wear and tear on the fleet and in the probability of catastrophic damage due to a major traffic accident. The approach and results of this study have been reviewed and approved by the TRADOC Systems Manager - Combined Arms Tactical Training, the Project Manager - Combined Arms Tactical Training and the Army National Guard Bureau and will be the basis for the fielding plan and CLS contract renegotiation.

Main Assumptions. The Training Directorate, Army National Guard, specified the M-CCTT training strategy. For enhanced brigades, the virtual component of the training strategy will consist of four M-CCTT training sessions per year. For non-enhanced brigades, the virtual component will consist of at least two M-CCTT training sessions per year. The maximum any enhanced brigade unit will travel is 50 miles, while non-enhanced brigade units will travel no more than 100 miles. Modification of these assumptions requires additional modeling effort.

Principal Limitations. Army National Guard force structure will remain valid when M-CCTT fleet is fielded. Significant modifications to the Army National Guard force structure and geographic location will necessitate additional model runs.

Scope. The project scope fully supports the Army National Guard's Simulator Training Strategy. The Army National Guard identified 583 armor, cavalry, and infantry armories, which were classified as either enhanced readiness units or non-enhanced readiness units. The classification of the units designated the virtual training strategy and the required amounts of training. These armories were to be serviced with only 21 M-CCTTs (10 infantry and 11 armor) over the course of the year.

Approach. Our approach to this problem was to construct and sequentially solve a number of integer programming optimization models. These are nontrivial combinatorial optimization problems: 583 armor, cavalry, and infantry armories, classified as either enhanced readiness units or non-enhanced readiness units, required different amounts of training with only 21 M-CCTTs (10 infantry and 11 armor). The output from one model yields input data for the subsequent model. First, a p-median type model determines where to locate each M-CCTT and which units each M-CCTT trains. The model decides where to home base the M-CCTT fleet by minimizing the distance from a home base to the units. This model tells us which units are within a predetermined criterion travel distance (specified by the Army National Guard Bureau) and which are outside the travel distance. Those units that are within the travel distance will train at the M-CCTT home base, while the M-CCTT must be moved to train the units that are outside the travel distance. For those units that are further away than the travel distance, we formulate and solve two models that route each M-CCTT. Using the units that are outside the travel distance as input data, a set cover model picks the minimum number of locations (either armories or local training areas) such that all units are within the distance limit of one of the selected locations. Using the set cover solution as data, we solve a traveling salesperson problem to determine the best route for the M-CCTT. The routing solution specifies both the minimum number of stops and the minimum distance path that the M-CCTT will make during a training year. In practice, the implementation of the solution means that the M-CCTT will travel to a small number of locations and rendezvous with nearby units where it will provide simulator training. After training all of these units, the M-CCTT will move to the next location, train nearby units and complete one cycle by returning to its home base.

Study Sponsor. Commandant, US Army Armor School, TRADOC Systems Manager-Combined Arms Tactical Trainer, Fort Knox, KY 40102-5200

Performing Organization. TRADOC Analysis Center - White Sands Missile Range, NM 88002-5502 (Study POC: Mr. Philipp A. Djang, 505-678-5298, DSN 258-5298)

DTIC Accession Number. DA 358601

THEATER MISSILE DEFENSE
ADVANCED WARFIGHTER
EXPERIMENT

PURPOSE

The TRADOC Analysis Center-Studies and Analysis Center (TRAC-SAC) was tasked to provide analytic support to the TMD-AWE Director's assessment of near and far term Army TMD capabilities and future identification of high payoff DTLOMS solutions to TMD shortcomings.

CRITICAL ISSUES ADDRESSED

1. What are the near (current) and far (programmed) term capabilities and deficiencies within each pillar of Army TMD?
2. What is the operational relationship among the four pillars of TMD?
3. What improvements in TMD capability can be achieved with doctrinal and/or material changes?

LITERATURE RESEARCH

A literature research was accomplished to insure that this study did not duplicate other efforts, either previously finished or ongoing. Studies reviewed included numerous analyses done on the individual pillars themselves, but did not address the integration of the fours pillars to determine high payoff DTLOMS.

THE PRINCIPAL FINDINGS

Passive Defense

1. Significant payoff from timely early warning.
2. The combination of early warning and counter reconnaissance measures minimize casualties.
3. Active defense of airfields and timely decontamination of certain units, especially attack helicopter units, are critical to maximize force effectiveness.

Attack Operations

1. Attack operations primarily impacts the threat's very short range TBM capability. Joint assets (both weapons and sensors) are needed to effect the total TBM threat.
2. Proactive attacks of threat infrastructure provide the greatest payoff.
3. Armed reconnaissance helicopter missions are desirable if survivability level is acceptable.
4. Threat use of underground facilities can significantly reduce attack operation effectiveness.

Active Defense

1. A near leakproof defense cannot be achieved in near term.
2. PAC-3 and THAAD provide a viable two tier defense capability.
3. Corps Sam significantly improves the active defense capability in the corps area.
4. A flexible firing doctrine and a force tailoring capability are essential to maximize effectiveness, especially when task organizing an early entry force package.

BMC4I

1. Attack operations and active defense bring complementary capabilities to the TMD battle
2. Limiting Patriot resources to defend EAC assets and integrating attack operations with active defense reduced the number of short-range threat systems effects by more than 60%.
3. Key systems providing attack operations detection data were the JSTARS E-8C and Guardrail Common Sensor.
4. Increased sensor capability must be accompanied by adequate attack systems.

MAIN ASSUMPTIONS

1. The scenarios used are representative of likely situations involving TMD.
2. U.S. and threat force structures and equipment used in the scenarios will perform according to their specifications. To the extent that they play in the scenarios USAF and USN systems will be represented, but the analysis will only address U.S. Army capabilities and deficiencies.
3. Current fielding dates for U.S. systems will not change.
4. Projected Army force structures for the time frame (FY01) are correct.

EXERCISE LIMITATIONS AND ARTIFICIALITIES

1. Incomplete Sensor Suite. National sensor systems played a limited role in the exercise. Not only was a full sensor suite not available, but participating sensors were present only during limited portions of the exercise. The most critical limitation in this area was the absence of JSTARS, or a suitable broad area MTI replacement, which led to a reduced capability to fuse intelligence data and limited the development of TBM target sets.
2. UAV Restricted Flight Paths and Times. Exercise safety constraints limited the area of operations for UAVs and imposed predetermined mission flight times. These conditions did not allow the Blue forces to take full advantage of their sensor capabilities and limited the ability of intelligence organizations to task/re-task sensors to search target locations using information provided by JTAGS or other missile warning systems (i.e., there was limited sensor cross-cueing capability).
3. Free Play Exercise. The TMD-AWE live exercise was a force-on-force free play exercise. This format did not allow the scripting of events (aside from simulated missile launches) or conditions that would assist in the data collection effort to ensure that sufficient meaningful data points were generated.
4. Data Collection Challenges. The extremely complex environment of a fast growing exercise, coupled with late decisions on exercise requirements and lack of time to properly train data collectors impacted on the amount of collected data which could be used with confidence in post-exercise analysis.

SCOPE OF STUDY

1. This study considered all four pillars of TMD (Passive Defense, Attack Operations, Active Defense and C4I.
2. This study examined current (FY95) and end of POM (FY01) TMD capabilities.
3. Both an early entry phase (day 7-9) and a decisive operations phase (day 70) were examined in SWA-N. The decisive operations phase was overlaid on the SWA 4.2 standard scenario to measure impact on force effectiveness. A NEA analysis used a ten sequence (days 0-9) from GPALS 92-2 scenario. A 2005 threat force structure was used in both SWA-N and NEA.

STUDY OBJECTIVE

1. Provide analytic support to the TMD-AWE Directors assessment of near and far term capabilities.
2. Develop a comprehensive, integrated analysis of TMD from existing documentation, model support, linkage of exercise data collection results to simulation output, and a detailed evaluation of capabilities within, and relationships between the four pillars of TMD.
3. Identify potential high payoff DTLOMS solution to current TMD shortcomings.

THE BASIC APPROACH

1. A model-exercise-model approach was utilized in order to leverage data and insights gained from Joint Project Optic Cobra (JPOC), the CINC level TMD experiment overlaid onto the integrated air defense live exercise Roving Sands.
2. Prior to the live exercise, a mission need, threat and doctrine analysis was conducted to develop a set of operational concepts and TTP alternatives. These alternatives were examined during pre-exercise modeling to develop the initial assessment of both near and far term TMD capabilities.

THE REASON FOR PERFORMING THE STUDY

The TMD-AWE is one of four primary FY95 advanced warfighting experiments that comprise Joint Venture (the plan leading to the development of Force XXI). This AWE will support the development of Army doctrine for TMD and prioritization of material requirements.

STUDY IMPACT

This study provided the analytical basis for the development of the draft FM 100-12, Theater Missile Defense Operations.

THE STUDY SPONSOR AND PROPONENT

Commandant, USAADASCH, ATTN: ATSA-CDF, Ft. Bliss, TX 79916.

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DTIC ACCESSION NUMBER

ADC 055048.

COMMENTS AND QUESTIONS MAY BE SENT TO

Performing Organization, DSN 552-5426/5427, Commercial (913) 684-5426/5427.

START AND COMPLETION DATES OF THE STUDY

OCT 94-SEP 95

United States/United Kingdom (US/UK) Combined Combat Identification (CID) Study

Study Gist

Study Purpose. The study sponsors Deputy Under Secretary of the Army for Operations Research (DUSA(OR) and Headquarters, Training and Doctrine Command (HQ TRADOC) Program Integration Office for Combat ID) requested that TRAC-WSMR work with the Defence Research Agency in the UK to address combat identification issues on a coalition battlefield using a common interactive wargame.

Critical Issues Addressed. This study addresses three of the fiscal year (FY) 96 study issues: joint venture, digitization of the battlefield and modernization.

Joint Venture: this was the first study effort that pursued developing a combined US/UK scenario for a peacekeeping mission specifically addressing coalition fratricide on the battlefield.

Digitization of the Battlefield: Depicted the first realistic situational awareness (SA) in the Janus simulation which is the major contribution of the digitized battlefield.

Modernization: Investigated the effectiveness of the Battlefield Combat Identification System (BCIS) device, a state-of-the-art technology that will be integrated into existing weapon systems.

Objectives. The study objectives were to develop and game a combined US/UK scenario that could be used to address CID issues, develop code for playing fratricide in the US Janus model, determine the extent that the use of SA information decreased fratricide and determine the effectiveness of CID devices in reducing fratricide without decreasing combat effectiveness.

Principal Findings

Any BCIS device reduces fratricide.

SA devices also can reduce fratricide.

Rules of engagement affect the fratricide results.

Forcing shooters and leaders to use SA information results in less fratricide and more combat effectiveness than allowing them to request it at their discretion.

Gaming a battle using both US and UK personnel increases the fidelity of the game because the tactics, training, and perceptions of both countries are reflected in battle results.

Impact/Utility. The US Army and the coalition forces do not currently have a ground-to-ground target identification device, nor have the coalition forces developed combined procedures for using a device if available. Furthermore, no high resolution scenario existed prior to this study that was developed and gamed by two countries for use in analyzing coalition issues. The results of this study provide the foundation (scenario, model code, etc.) for the International Combat Identification Study (US, UK, GE, and FR) and effort to address dismounted soldier issues using the Janus combat simulation. This study provided invaluable insights into the importance of conducting combined analysis in the future and has shown how an entire study (developing a scenario, gaming, analyzing data, and documenting study results) can be accomplished with one of our allies. The Janus code developed for this study allows units to appear as unknowns or generic icons until a higher level of acquisition is attained. This is a monumental breakthrough which will extend the use of the model to addressing digitization issues in the future. Since Janus is the most proliferated high resolution model in the world, the impact of these code changes is far-reaching.

Main Assumptions

Force structure and employment of Blue and Threat forces will follow current doctrine. The selected time frame for the Blue/Threat forces was present day.

The high resolution scenario (based on an engagement in central Europe), and the fratricide that occurs, could realistically occur.

Data used in the study are accurate and complete.

Attenuation of laser range finders and BCIS millimeter wave were assumed to be negligible.

US/UK forces operate compatible BCIS systems. The reliability of this device was assumed to be perfect.

Principal Limitations

Command and control communications between the US and UK forces were represented by message traffic through head phones or conversationally through the "sector commander." Only delays in communications were varied.

Decisions to fire individual weapons are embedded within the acquisition model in the Janus code and are based on resolvable cycles; human decision processes were not considered.

Investigation of BCIS effectiveness was limited to results from the Janus model; laser ranging was always correct and BCIS reliability was perfect.

Modeling SA is limited to providing friendly location information and all current detections by friends upon request.

The fact that no misidentification data were available prevented fratricide from occurring when systems were required to achieve identification prior to engaging.

Scope. The study focused on three study areas: development of a US/UK scenario, investigation of SA, and the determination of the effectiveness of the CID device.

Approach

The first step was to develop a combined US/UK scenario for an operation other that war (OOTW) that had plausible instances of fratricide. Of primary concern was developing a scenario that portrayed a peacekeeping mission that would be conducted by the US and UK in a specific part of the world. Subsequently, the data pertaining to terrain and units were entered into the US version of the Janus interactive high resolution combat simulation. The US developed the necessary Janus code to allow realistic friend-on-friend engagements.

The second area of interest was to investigate the extent to which increased SA information reduced fratricide without decreasing combat effectiveness. This was accomplished by varying the time friendly battlefield information updates were received by each of the Janus gamers.

The last area investigated was the determination of the effectiveness of the US Army's BCIS in reducing fratricide without decreasing combat effectiveness. This was accomplished by developing Janus code to represent BCIS, then executing Janus runs with and without the device.

Study Sponsors. US: DUSA(OR) and HQ TRADOC Program Integration Office for Combat Identification. UK: Directorate of Science (Land), Ministry of Defence

Performing Organizations. The US study agency was the TRADOC Analysis Center-White Sands Missile Range (POC: MAJ Geoffrey Coleman, COMM 505-678-1461, DSN 258-1461). The UK study agency was the Defence Research Agency, Fort Halstead (POC: Mr. Dion Wardleworth, COMM 011-44-1959-515388)

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ABSTRACTS OF THE DR. WILBUR B. PAYNE MEMORIAL

AWARD FOR EXCELLENCE IN ANALYSIS 1995 PAPERS

1995
Dr. Wilbur B. Payne Memorial Awards
for Excellence in Analysis

Citations

Individual Author

Captain Thomas M. Cioppa, Military Analyst, Study and Analysis Center, US Army TRADOC Analysis Center, Fort Leavenworth, KS, is commended for his efforts in the origination, development, and use of Force Tailoring Tools. The Force Tailoring Tools use fuzzy set theory, artificial intelligence, and linear programming to structure a new analytical process for developing force packages. The tools capture expert military judgment in mathematical models to arrive at the appropriate force. The tools allow decisionmakers and planners to adapt to changing environments by quickly determining optimum forces for any possible conflict.

The Force Tailoring Tools consist of four computer programs. FORCE-PLUS (Force Package Logic Utility System) is an expert system used to identify units to add to a force package. SCRAP (Sufficiency Criteria for Realignment Adjustment Processor) is a spreadsheet used to identify units to delete from a force. EFFORT (Early Entry Force Tailoring Tool) is an integer goal program used to develop force packages. THOR (The Task Organizer) is an integer goal program used to task-organize forces.

The Force Tailoring Tools offer marked advantages to the operational and the analysis communities. The tools allow analysts to design force packages for examination in constructive simulations and more readily identify the optimum force based on given force goals. The tools allow commanders and staffs the opportunity to tailor forces rapidly, given threats, operational locations, and goals. The benefits of the new tools have been demonstrated in several studies including the *Early Entry Forces Analysis*, the *Mobile Strike Force 95 Organizational and Operational Analysis*, the *US Army Command and General Staff College Battle Command Elective*, and the *98-12 Warfighting Lens Analysis*. The tools evolve and mature with each application.

For this noteworthy and innovative application of analytical techniques, Captain Thomas M. Cioppa has been selected to receive the 1995 Dr. Wilbur B. Payne Memorial Award for Excellence in Analysis.

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Group Authors

Major Braddock B. Scott, Military Analyst, and **Mr. Philipp A. Djang**, Operations Research Analyst, Training Analysis Directorate, US Army TRADOC Analysis Center, White Sands Missile Range, NM, are commended for their work on the *Reserve Component Mobile Close Combat Tactical Trainer Training Integration and Deployment* study.

The study determined where to station and how to route the Mobile Close Combat Tactical Trainer fleet to provide the maximum training opportunities for Reserve Component units distributed widely throughout the United States. The authors formulated and sequentially solved three combinatorial integer programming models that select the best locations for basing the fleet, identify the sites each Mobile Close Combat Tactical Trainer should travel to, and determine the best route. The innovative vehicle routing models insure that all units receive the required amount of training while minimizing the distance and the number of moves the units to be trained and the Mobile Close Combat Tactical Trainers make each year.

The results of the intelligent routing are expected to reduce annual fleet operating costs by more than 80 percent for a saving of more than $1 million per year over the life of the trainer system. The savings may increase, depending on final fleet configuration. An additional one-time savings, of more than $3 million , is expected from the reduction in the number of armory upgrades. In addition to cost savings, the approach permits quick exploration of the effects of changing training policy parameters, such as training frequency and force structure, as well as a rapid selection of which Mobile Close Combat Tactical Trainers can be available for additional training. The work supports the Army National Guard's Simulator Training Strategy.

For this outstanding and creative use of classical operations research models, and the resulting expected cost savings, Major Braddock B. Scott and Mr. Philipp A. Djang have been selected to receive the 1995 Dr. Wilbur B. Payne Memorial Award for Excellence in Analysis.